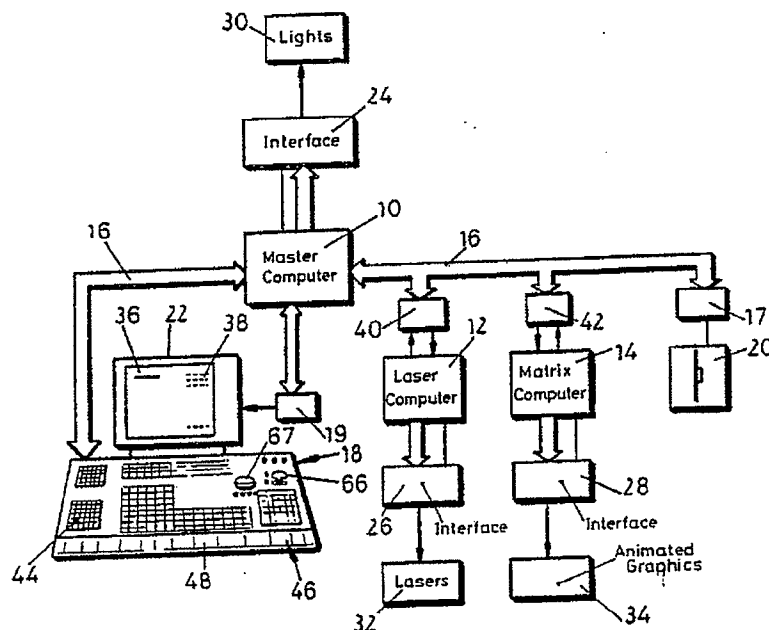


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(54) Title: PROGRAMMABLE CONTROL SYSTEM**(57) Abstract**

An electrical control system for controlling a plurality of devices (30) comprises a computer based control unit including at least one computer (10) coupled to an interface (24) and to the plurality of devices (30) which may be lighting elements. A keyboard (18) is connected to computer (10) together with a VDU (22) to enable an operator to select and view a menu display (36, 38) of programs held in a disc drive unit (20) for controlling the devices (30).

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PROGRAMMABLE CONTROL SYSTEM

The present invention relates to a control system, particularly, but not exclusively, to a lighting control system for controlling a plurality of lights and other devices in a common environment.

5 In environments such as discotheques and night clubs, lighting is available from a plurality of sources such as lasers, flashing lights, dimmers, animated graphics and the like. At present, separate controllers are available for individual devices such as dimmers, switch devices,
10 lasers, robots and other mechanically adjustable device and graphic displays and moving messages.

With some existing systems this can mean that the controllers are disposed in separate panels and as many as ten control panels can be required to provide
15 satisfactory control of the lighting elements. This is ergonomically difficult for a single person to operate and because the control panels are separate individual interfaces are required for each element and this can be difficult and time consuming to set up. The complexity
20 of such an existing system is such that control is inadequate and limits the variety and flexibility of lighting effects that it would be expected to be achieved from such a variety of lighting devices.

With other types of existing systems a separate
25 controller is connected to the separate controllers of each individual device and although this system permits some improvement it is inflexible and restricts the number and variety of lighting effects available with the aforementioned system. Attempts to improve the
30 flexibility of the controller result in complexity and ergonomic problems.

An object of the present invention is to provide an improved lighting control system which obviates or mitigates the disadvantages associated with the

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aforementioned existing arrangements.

This is achieved by providing a programmable control system including a single keyboard operated unit, which is interfaced to all the electrically controlled elements to permit a single person to readily control the selection and variety of sequences to be applied to the elements using the keyboard.

In a preferred arrangement, this is achieved by interfacing a custom designed keyboard with a microprocessor controlled visual display unit (VDU). The microcomputer is coupled via an interface to lighting control elements such as lasers, dimmers and flashing lights. A plurality of lighting control programs are stored in a memory associated with the microcomputer and these programs can be called up by the operator using the keyboard so that the existing program currently controlling a preselected lighting sequence is displayed on the screen and a menu or list is presented on the screen of available remaining lighting programs for future selection by the operator.

The programs can be readily updated by using an external memory such as a disk which can be loaded with new programs to provide further variety and control of lighting sequences. Customised interfaces permit control of lasers, dimmers and lights as well as other lighting elements.

In the arrangement an IBM P.C. (or compatible) is used as a host computer and disk-based software can be upgraded and stored in a random access memory (RAM) for longer term reliability to increase speed and cost.

Three such computers are combined in a unitary arrangement and controlled by the keyboard to permit a flexible control arrangement to control a master, a laser and a matrix control system. Each computer has its own operating system with a bi-directional RS232 data communications bus linking the computers together.

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A wide range of software defined assignable controls are incorporated into the system allowing fast access for controlling different devices with the same control. This permits additional devices to be added at a later date with control LEDs according to user preference. Such additional devices are a joystick for controlling robots and/or a laser or the input to a matrix display for moving images and an encoder for varying the speed of the display. A touch panel can also be incorporated and this can be assigned to any function or combination of functions from switching a single motor to initiating a complete system blackout.

Accordingly, in one aspect of the present invention there is provided an electrical control system for controlling a plurality of devices, said system comprising a computer based control unit coupled to an interface which, in turn, is adapted to be coupled to a plurality of devices, said computer based control unit having a keyboard associated therewith, said keyboard being operable by a user to select a program from a predetermined list of programs and to control the operation of the devices in accordance with the selected program.

Preferably also, the electrical control system includes a visual display unit (VDU) for displaying the selected program currently controlling the devices and for displaying a list of alternative programs which can be selected by the operator at a future time.

Preferably also, the programs can be stored in an external disk or in a random access memory (RAM) coupled to the computer.

Preferably also, the electrical control system is a lighting control system for use in lighting and audio displays involving control of lights, dimmers, lasers and the like.

Preferably also, a plurality of additional devices

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are coupled to the system to permit the control of apparatus other than lights, for example, a robot or an animated graphic system.

5 Preferably also, the computer based control unit is provided by three personal computers (P.C.s) coupled together on a bi-directional data bus. The computer based control unit having a disk drive associated therewith.

10 Preferably also, the keyboard contains keys which are assignable to the specific functions required by the control system to permit the operator to operate all elements of each plurality of devices connected to the control system from said keyboard.

15 According to a further aspect of the present invention there is provided a method for controlling a plurality of devices coupled to an electrical control system, said method comprising the steps of:

20 entering a control command through a keyboard associated with a computer based electrical control system;

selecting a device control program from a store of such programs in accordance with said input information, and

25 actuating said devices coupled to said electrical control system to operate in accordance with the control information within said program.

30 Preferably, said method includes the steps of displaying to the user an identification of the program selected which is presently controlling the electrical control system, and displaying to the user a list of alternative programs in said store which the user can select at a future time.

35 These and other aspects of the present invention will become apparent from the following description when taken in combination with the accompanying drawings in which:-

Fig. 1 is a schematic diagram of an embodiment of a

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lighting control system in accordance with an aspect of the present invention;

Fig. 2 is a detailed view of the keyboard layout of the keyboard shown in Fig. 1;

5 Figs. 3, 4 and 5 are schematic diagrams of the control layout of each of the computers used to control the master, laser and matrix control systems associated with the apparatus and keyboard shown in Fig. 1 and Fig. 2.

10 Reference is first made to Fig. 1 of the drawings which is a schematic overall block diagram of an embodiment of a lighting control system. The system is based on three computers, a master computer 10 for controlling lights, dimmers and the like, a laser
15 computer 12 for controlling lasers, and a matrix computer 14 controls animated graphics and moving displays. The computers 10, 12 and 14 are coupled via an IBM Expansion bus 16 to each other and to a custom built keyboard 18. The master computer is also coupled via the bus 16 and
20 adapters 17, 19 to a disk drive 20 and to a VDU 22 respectively in accordance with known techniques. Each computer 10, 12 and 14 is respectively connected to a device interface 24, 26, 28 which interfaces between the computer control system and the devices to be driven by
25 the lighting control system, such as lights 30, lasers 32, and animated graphics 34. The disk drive 20, or a Random Access Memory (RAM) in the master computer may contain programs for controlling various lighting sequences using various combinations of the
30 aforementioned devices coupled to the interfaces as will be later described.

In general, the operator selects, according to a desired key code on the keyboard, a program stored in the disk or RAM to control the devices in a first lighting or
35 operating arrangement. The program is selected from a list of programs stored in the disk or RAM and passed, by

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the computer, through the interface 24 to control the devices. Simultaneously, the selected lighting sequence program 36 is displayed on the VDU 22 together with a list or menu 38 of other available programs stored in the RAM so that the operator can select, at a later time, other programs from the list for controlling different sequences or lighting arrangements as will be later described in detail.

The master computer 10 has a central processing unit based on a IBM P.C. (or compatible type computer) which acts as the host computer. In fact, all three computers 10,12 and 14 are used in the present system for the master, laser and matrix control systems. The IBM P.C. or compatible type computer has been selected because it is reliable, relatively inexpensive and contains 640K memory and run at 4.77 megahertz. The use of disk based software permits easy upgrading but once software design has been proved it is possible to install the software in a RAM for longer term reliability to increase speed and cost. The latter requirements are really only applicable to the laser control system because both the master and matrix control systems require removable mass storage.

Each P.C. computer contains its own operating system and is coupled to the bidirectional RS232 communications bus 16 via I/O Serial Ports 40,42 being used to link the computers 10,12 and 14 together.

Separate computers have been used to facilitate reliability so that in the event of the master computer failing the laser or matrix computers can be put into an "auto-program" mode which can still provide useful effects. The system is also flexible because the matrix and laser controllers are easily modified to operate as stand alone controllers with their own simplified keyboard. The system is readily expandable, for example, if a more sophisticated matrix controller is developed it can readily be integrated with existing master

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controllers with minor control software modifications required in the master. In addition, separate computers are preferred because they generally have more capacity than a single computer and permit more flexible control of the matrix animated graphic and laser displays which require considerable amount of memory for prepared data. In the the present case, the whole system is written in a high level language to facilitate control.

Control of all three computers is effected using the keyboard 18 which contains a plurality of keys 44 arranged in various groups on the keyboard as can be seen in Fig. 2. In addition, at the front of the keyboard there is a foil strip 46 containing thirty two foil rectangles 48 running along the front of the keyboard as best seen in Fig. 1. The foil strip is a touch panel which can be used by the operator as a switch to control the flashing of lights etc., as will be later described.

Reference is now made to Fig. 3 of the drawings which is a schematic block diagram of layout of the master computer 10. The master computer 10 is based on the IBM P.C. The master computer 10 uses a system of continual refresh because most devices require continual modification, for example, robots must be taken through every step of a sweep. The IBM P.C. transfers data 50 under a DMA (Direct Memory Access) control 51 to the interface 24 in the form of a robot serial converter/formatter 52 which forwards the serial output to control robots coupled thereto. The robots have inbuilt serial to parallel circuitry. The data is transferred directly from the computer memory (not shown in the interest of clarity) which permits the main process to proceed independently of output timing considerations at a much reduced processor overhead.

Data is also connected to a general serial converter which sends out serial data to various devices such as lights 30 and to the keyboard LED display driver 57 under

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control of a further DMA control channel 56. An audio trigger input 63 can receive audio input data via a 4 band filter (base, treble, middle etc.) and trigger (not shown) and the data is fed to a VIA (Versatile Interface Adaptor) 65 to give sound to light control.

The keys 44 of the keyboard are coupled to keyboard scanners 60 and this information is multiplexed by a multiplexer 62 and fed through the VIA (Versatile Interface Adapter) 65 to processor 46 to indicate to the processor which key combinations have been selected. In addition, various peripherals such as joystick 66, and encoder 67 can be fed to the IBM P.C. 10 via analogue to digital converter 68 and encoder condition/count unit 69 respectively. The touch panel detector 40, joy stick 66, encoder 67 and keyboard scanners 60 as well as the LED display drivers 57 are all contained within the keyboard 18 shown in Fig. 1.

The master computer 10 uses interrupt driven initiation of DMA transfers, and sub-sequencers may be used with the interrupt to avoid minor hiccups visible during more complex operations.

Reference is now made to Fig. 4 of the drawings which is a schematic block diagram of the laser control system based on an IBM P.C. 12 and interface 26. Direct memory access (DMA) driven digital to analogue converters 82 are used for high speed pattern generation, which requires up to 200 kilobytes per second, and an interrupt driven output control 84 is connected to low speed modulation and position digital to analogue converters (DAC's) 86 which are in turn coupled to the scanners of lasers 32. The output is a voltage in the range -6v to +6v to control laser movement. Although only one channel is shown in Fig. 4 it will be appreciated that this arrangement is repeated for other channels. The laser system includes a "watchdog" fail safe hardware timer 88 which must be re-set by software to keep the laser

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shutter open. The timer control data is passed from the IBM P.C. 12 through a VIA 90 to a sundry laser control or shutter grate to parallel switches associated with the laser which can be switched in accordance with existing know-how (e.g. using a 3-bit part) to create different patterns.

Reference is now made to Fig. 5 of the drawings which is a schematic diagram of the matrix lighting control system layout. This is based on the IBM P.C. host computer 14 which uses a 500 kilobit per second serial link 92 to provide multiplexed full colour operation at up to 50 frames per second for fast graphic animation effects. Output is achieved with a direct memory access control channel 94 to a serial port. The output is fed to a serial to parallel converter 92 so that the animation effects are displayed on a lamp matrix (not shown).

A lamp driver control circuit is provided by a VIA 96 coupled to a pre-heat control unit 97 under the control of an I/O control line 98. Timer 99 controls DMA triggering and interrupts as in the laser computer 12. This control sequence is designed to provide a pre-heat system to allow use of sensibly rated incandescent lamps (2 watts). The unit 97 permits control of the multiplexing of 4 colours, red, green, blue and white. The lamp drivers use an eight-way Darlington IC taking advantage of the low cost of such devices. This avoids 8 to 10 times current surges associated with the switching on of the cold lamp. This has been achieved by using protection diodes built into the Darlington IC and drawing a pulse of current through each lamp every 20 milliseconds. This current pulse is sunk via a common terminal on the Darlington IC by an external transistor with current limiting so that the cold current is limited to a safe peak value for the darlington IC diodes. The pulse is detected and filtered to give a long time delay

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before enabling the gates controlling the lamps to respond to animation data.

This system avoids the assembly costs and heat generation associated with individual pre-heat diodes/resistors or thermistors. If no pre-heating is used then grossly overrated transistors are required and the power supply surges are enormous if the display is flashed. The average rating of the display is 8 kilowatts but surges could be as much as 64 kVA without pre-heat placing considerable strain on power supply components. With the present arrangement of pre-heat control, surges are limited to around 16 kVA under most conditions. The receivers incorporate hardware monitoring of the pre-heat pulse and disabling the input to the Darlington IC during power-on, reconnection of data links or if the pulse is not present for any reason.

A spectrum analyser 102 associated with the matrix computer is coupled under direct memory access (DMA) control to the IBM P.C. 10 consists of; 30 double-tuned switching capacitor filters to provide one third octave filtering, a logging amplifier to give decimal scaling; a multiplexer, and an analogue to digital control. Data 104 is read in from the processor using direct memory access 105 to permit fast and constant multiplexing around 50 complete scans per second. This is processed by the computer after each scan to provide a real-time bar-graph display and is also used to act as a trigger for the audio trigger input 63 connected to the VIA 67 in Fig. 3. The 4 bands can be increased to about 30 bands to provide a greater variety of audio inputs and hence sound to light control. There is also a VCA on the audio input 106 for automatic level adjustment.

It will also be appreciated that with the aforementioned system extra devices may be added at a later time or the controls customised to user preference. Such extra devices may be the joystick 66

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for controlling robots, a laser and an input to a matrix display for controlling moving images. This can permit control in the velocity or the position mode, as required and can also be used to adjust the size of laser patterns. The touch panel 48, which can be assigned to any function from switching a single motor to initiating a complete system blackout, and an encoder for "analogue" adjustment for speed levels etc., can also be incorporated. A group of 16 select switches can be used in conjunction with a numeric keypad to provide easy selection from menus and furthermore, additional numeric and "qwerty" keypads can be used.

Advantages of the lighting control system hereinbefore described are that a plurality of complex control functions for a lighting system having many different types of lighting elements and other devices can be controlled from a single control panel with a programming facility. This provides the benefit of user programming procedures being rationalised and in a common format because individual controllers all have different procedures, leading to confusion. All devices can be programed to operate in a synchronised fashion and a single operation can, for example, cut all general lighting and switch on the laser; or allow tracking of the laser to a graphics image on the matrix display for highly effective light shows. The use of a single control system permits all pre-sets to be named and clearly displayed on the display unit to provide menus or lists of the available selection avoiding confusion over numbered entries. The system also permits all data relating to the entire system to be kept on a disk for security, allowing time to be spent on creating a show with minimal risk of loss in contrast with individual devices which generally have no disk so that although some have battery backed memory, in the event of failure this is not transferrable to a replacement system. Also

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each computer is self-contained and has a front panel selectable "back-up" switch which can put the laser or matrix computers into an "auto-program" mode so that in the event of the master computer failing the Laser and
5 Matrix computers can operate to provide useful effects.

In addition, the system has a large selection of immediately accessible presets without having to go through menus, that is 64 keys and eight groups of 8 may be assigned to any mixed preset types. There is also a
10 desk facility where the current mix of selections of banks can be stored and recalled allowing for example, four of the eight banks to be switched immediately from 32 laser presets to a mixture of matrix and robot types. This creates a "virtual" control panel for a vast
15 selection of options which are quickly and easily selectable.

There is also a facility to permit immediate and temporary modification of existing presets where this is useful, for example, colours, speeds etc. This avoids
20 multiple presets in similar settings and allows the user to perform actions spontaneously without affecting the stored presets. The LED indicators provide a clear confirmation of selection in a darkened environment and wherever possible "default" selection is assumed if a key
25 stroke is skipped, so for example if the robot colour is changed and no entry is made for the selection of the robots 1 to 16 it assumes that the last choice is still valid.

A set-up preset type is provided which contains a
30 combination of the actual device presets, the laser, matrix etc. and allows several devices to be started together in a convenient fashion. Furthermore, switch-on codes are entered which restrict access to one of three levels although this is extendable as required. For
35 example, one level could be code for a user without entry allowed to any programming function avoiding corruption

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of carefully prepared light shows and disabling the laser for safety reasons; another level could be a code for a user + laser + program which permits this user full access to all the facilities. Such codes can be revealed to selective authorised user and installers and may be changed as required.

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CLAIMS

1. An electrical control system for controlling a plurality of devices, said system comprising a computer based control unit 10 coupled to an interface 30 which, in turn, is adapted to be coupled to a plurality of devices 30, said computer based control unit 10 having a keyboard 18 associated therewith, said keyboard 18 being operable by a user to select a program from a predetermined list of programs 38 and to control the operation of the devices 30 in accordance with the selected program 36.
2. An electrical control system as claimed in claim 1, wherein the electrical control system includes a visual display unit (VDU) 22 for displaying the selected program 36 currently controlling the devices 30 and for displaying a list 38 of alternative programs which can be selected by the operator at a future time.
3. An electrical control system as claimed in either preceding claim, wherein there are first, second and third pluralities of devices (30, 32, 34) and the computer based control unit comprises first, second and third computers 10, 12, 14 coupled together on a directional data bus 16 and coupled to the respective pluralities of devices 30, 32, 34 through interfaces 24, 26, 28 at least one of said pluralities of devices 30, 32, 34 comprising a plurality of lighting elements.
4. An electrical control system as claimed in any preceding claim, wherein the keyboard 18 contains keys 44 which are assignable to the specific functions required by the control system to permit the operator to operate all elements of each plurality of devices 30, 32, 34 connected to the control system from said keyboard.
5. A method for controlling a plurality of devices coupled to an electrical control system, said method comprising the steps of:
- entering a control command through a keyboard

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associated with a computer based electrical control system;

selecting a device control program from a store of such programs in accordance with said input information,
5 and

actuating said devices coupled to said electrical control system to operate in accordance with the control information within said program.

6. A method as claimed in claim 5, wherein said method
10 includes the steps of displaying to the user an identification of the program selected which is presently controlling the electrical control system, and displaying to the user a list of alternative programs in said store which the user can select at a future time.

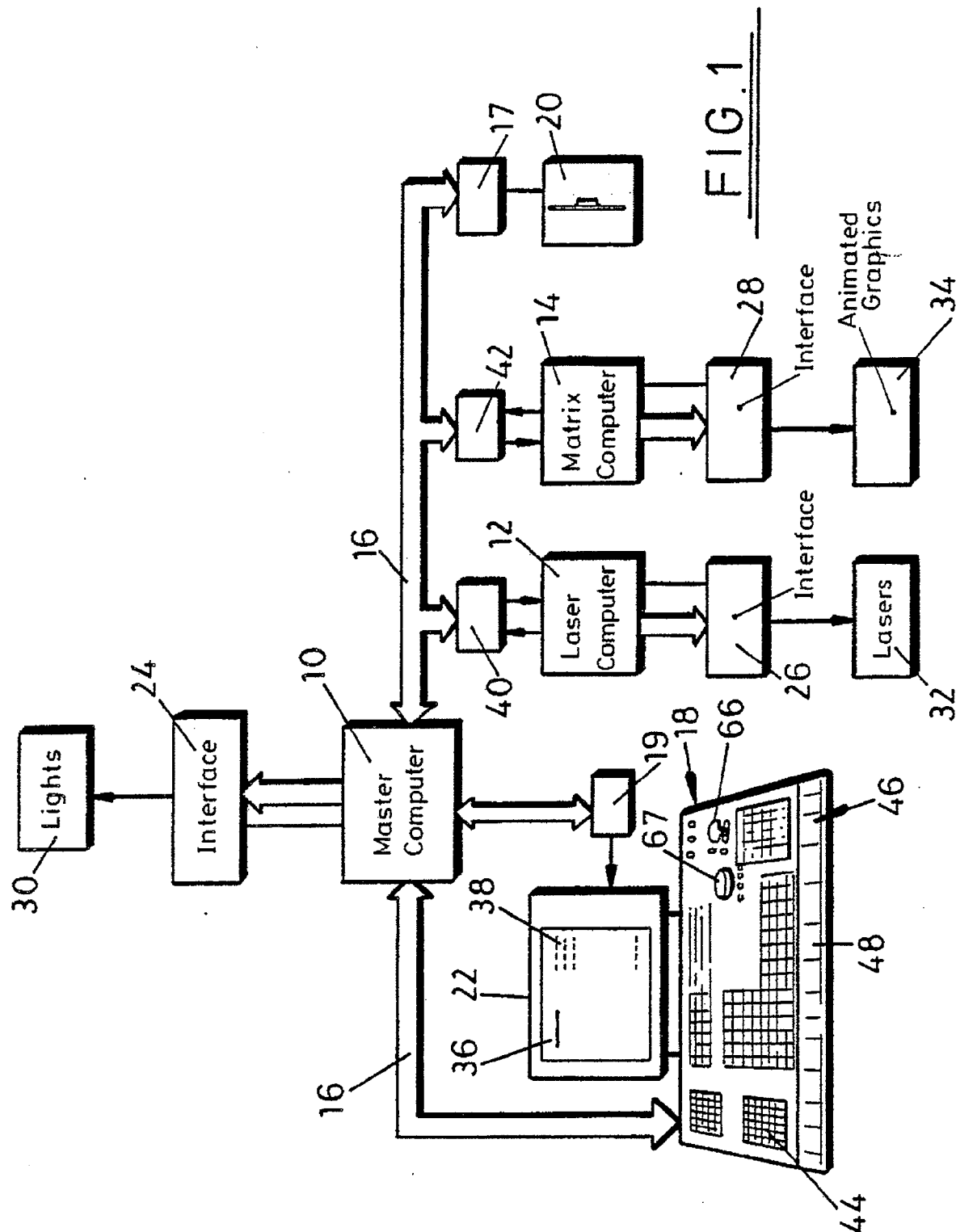


FIG. 1

40

1 231	2 221	3 211	4 201	5 191	6 181	7 171	8 161	9 151	10 141	11 131	12 121	13 111	14 101	15 091	16 081	17 071	18 061	19 051	20 041	21 031	22 021	23 011	24 001
25 236	26 226	27 216	28 206	29 196	30 186	31 176	32 166	33 156	34 146	35 136	36 126	37 116	38 106	39 096	40 086	41 076	42 066	43 056	44 046	45 036	46 026	47 016	48 006
49 237	50 227	51 217	52 207	53 197	54 187	55 177	56 167	57 157	58 147	59 137	60 127	61 117	62 107	63 097	64 087	65 077	66 067	67 057	68 047	69 037	70 027	71 017	72 007
73 238	74 228	75 218	76 208	77 198	78 188	79 178	80 168	81 158	82 148	83 138	84 128	85 118	86 108	87 098	88 088	89 078	90 068	91 058	92 048	93 038	94 028	95 018	96 008
97 239	98 229	99 219	100 209	101 199	102 189	103 179	104 169	105 159	106 149	107 139	108 129	109 119	110 109	111 099	112 089	113 079	114 069	115 059	116 049	117 039	118 029	119 019	120 009
121 240	122 230	123 220	124 210	125 200	126 190	127 180	128 170	129 160	130 150	131 140	132 130	133 120	134 110	135 100	136 090	137 080	138 070	139 060	140 050	141 040	142 030	143 020	144 010
145 241	146 231	147 221	148 211	149 201	150 191	151 181	152 171	153 161	154 151	155 141	156 131	157 121	158 111	159 101	160 091	161 081	162 071	163 061	164 051	165 041	166 031	167 021	168 011
169 242	170 232	171 222	172 212	173 202	174 192	175 182	176 172	177 162	178 152	179 142	180 132	181 122	182 112	183 102	184 092	185 082	186 072	187 062	188 052	189 042	190 032	191 022	192 012
193 243	194 233	195 223	196 213	197 203	198 193	199 183	200 173	201 163	202 153	203 143	204 133	205 123	206 113	207 103	208 093	209 083	210 073	211 063	212 053	213 043	214 033	215 023	216 013
217 244	218 234	219 224	220 214	221 204	222 194	223 184	224 174	225 164	226 154	227 144	228 134	229 124	230 114	231 104	232 094	233 084	234 074	235 064	236 054	237 044	238 034	239 024	240 014
241 245	242 235	243 225	244 215	245 205	246 195	247 185	248 175	249 165	250 155	251 145	252 135	253 125	254 115	255 105	256 095	257 085	258 075	259 065	260 055	261 045	262 035	263 025	264 015
265 246	266 236	267 226	268 216	269 206	270 196	271 186	272 176	273 166	274 156	275 146	276 136	277 126	278 116	279 106	280 096	281 086	282 076	283 066	284 056	285 046	286 036	287 026	288 016
289 247	290 237	291 227	292 217	293 207	294 197	295 187	296 177	297 167	298 157	299 147	300 137	301 127	302 117	303 107	304 097	305 087	306 077	307 067	308 057	309 047	310 037	311 027	312 017
313 248	314 238	315 228	316 218	317 208	318 198	319 188	320 178	321 168	322 158	323 148	324 138	325 128	326 118	327 108	328 098	329 088	330 078	331 068	332 058	333 048	334 038	335 028	336 018
337 249	338 239	339 229	340 219	341 209	342 199	343 189	344 179	345 169	346 159	347 149	348 139	349 129	350 119	351 109	352 099	353 089	354 079	355 069	356 059	357 049	358 039	359 029	360 019
361 250	362 240	363 230	364 220	365 210	366 200	367 190	368 180	369 170	370 160	371 150	372 140	373 130	374 120	375 110	376 100	377 090	378 080	379 070	380 060	381 050	382 040	383 030	384 020
385 251	386 241	387 231	388 221	389 211	390 201	391 191	392 181	393 171	394 161	395 151	396 141	397 131	398 121	399 111	400 101	401 091	402 081	403 071	404 061	405 051	406 041	407 031	408 021
409 252	410 242	411 232	412 222	413 212	414 202	415 192	416 182	417 172	418 162	419 152	420 142	421 132	422 122	423 112	424 102	425 092	426 082	427 072	428 062	429 052	430 042	431 032	432 022
433 253	434 243	435 233	436 223	437 213	438 203	439 193	440 183	441 173	442 163	443 153	444 143	445 133	446 123	447 113	448 103	449 093	450 083	451 073	452 063	453 053	454 043	455 033	456 023
457 254	458 244	459 234	460 224	461 214	462 204	463 194	464 184	465 174	466 164	467 154	468 144	469 134	470 124	471 114	472 104	473 094	474 084	475 074	476 064	477 054	478 044	479 034	480 024
481 255	482 245	483 235	484 225	485 215	486 205	487 195	488 185	489 175	490 165	491 155	492 145	493 135	494 125	495 115	496 105	497 095	498 085	499 075	500 065	501 055	502 045	503 035	504 025
505 256	506 246	507 236	508 226	509 216	510 206	511 196	512 186	513 176	514 166	515 156	516 146	517 136	518 126	519 116	520 106	521 096	522 086	523 076	524 066	525 056	526 046	527 036	528 026
529 257	530 247	531 237	532 227	533 217	534 207	535 197	536 187	537 177	538 167	539 157	540 147	541 137	542 127	543 117	544 107	545 097	546 087	547 077	548 067	549 057	550 047	551 037	552 027
553 258	554 248	555 238	556 228	557 218	558 208	559 198	560 188	561 178	562 168	563 158	564 148	565 138	566 128	567 118	568 108	569 098	570 088	571 078	572 068	573 058	574 048	575 038	576 028
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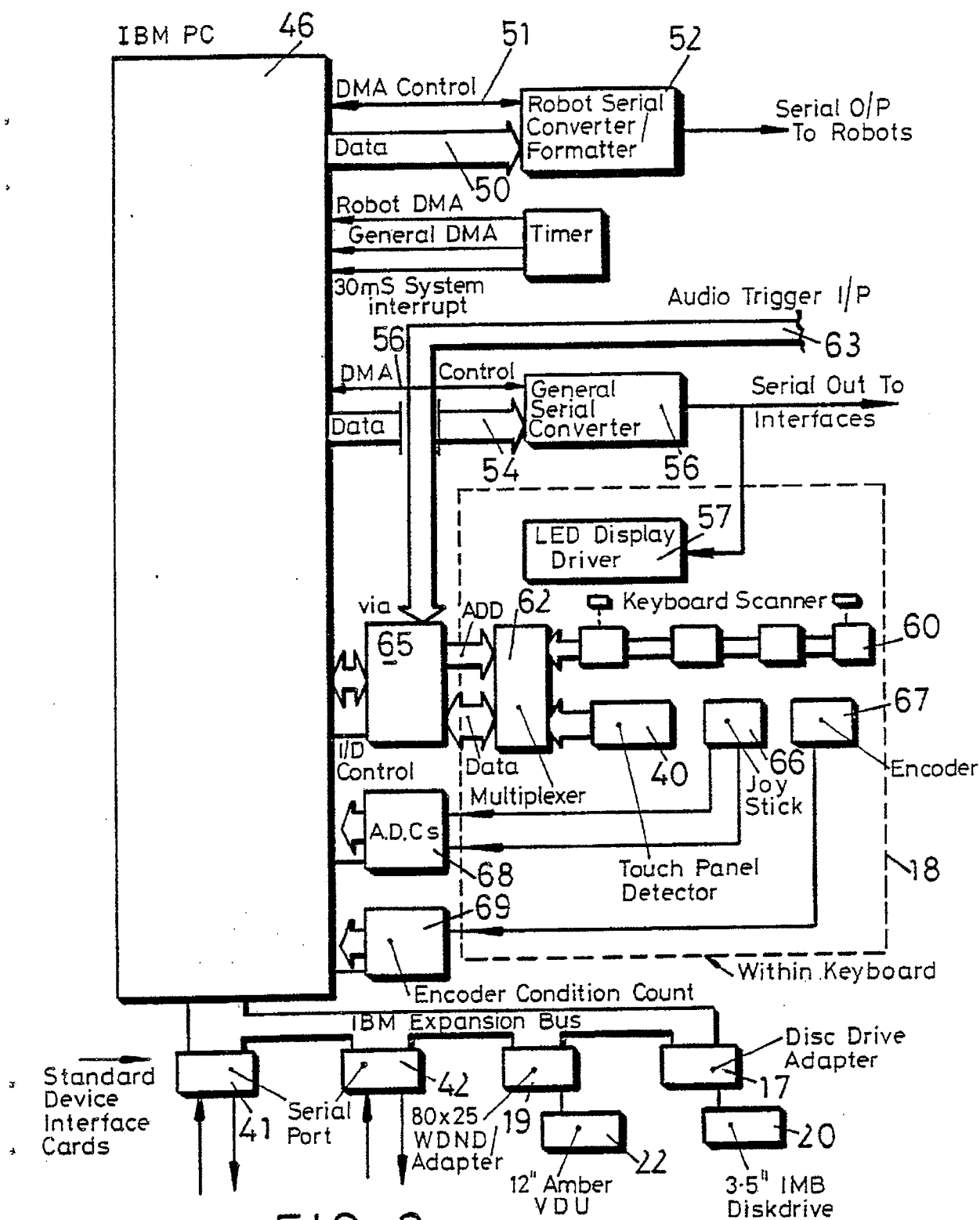
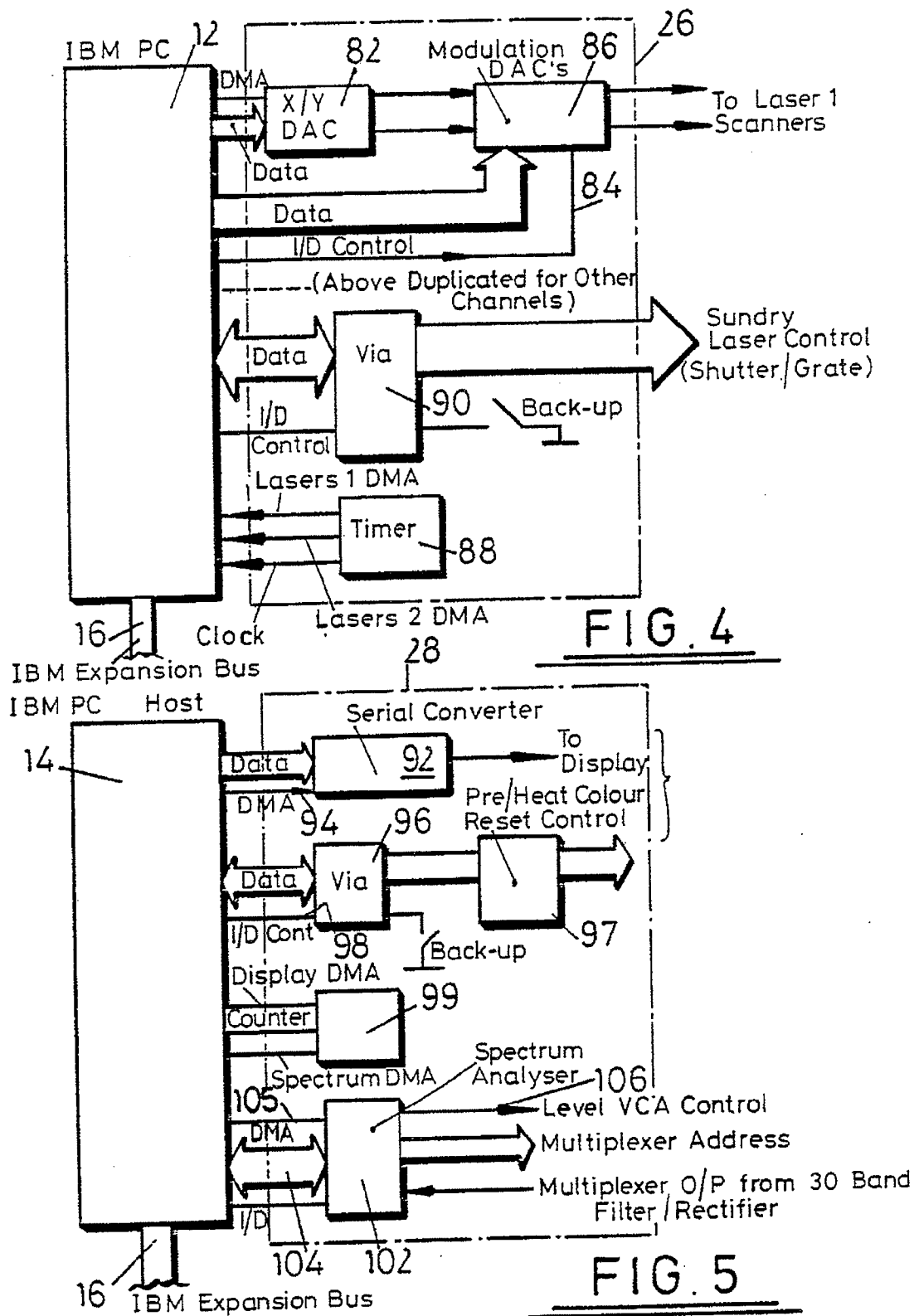


FIG. 3

SUBSTITUTE SHEET



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/01029

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : H 05 B 37/02																				
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC⁴</td> <td style="padding: 5px;">H 05 B; G 05 B; F 21 P</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	IPC ⁴	H 05 B; G 05 B; F 21 P														
Classification System	Classification Symbols																			
IPC ⁴	H 05 B; G 05 B; F 21 P																			
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category ⁹</th> <th style="width: 70%; border-bottom: 1px solid black;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 20%; border-bottom: 1px solid black;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">US, A, 3898643 (ETTLINGER) 5 August 1975 see column 2, line 65 - column 3, line 57; column 5, line 26 - column 7, line 29; figures 1-4</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1, 2, 4, 5</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="text-align: center; vertical-align: top; padding: 5px;">3</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">FR, A, 2466051 (D'AUZAC) 27 March 1981 see the whole document</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1, 5</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">DE, A, 3446113 (THOMA) 10 July 1986 see the whole document</td> <td style="text-align: center; vertical-align: top; padding: 5px;">3</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 10px;">-----</td> </tr> </table>			Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	US, A, 3898643 (ETTLINGER) 5 August 1975 see column 2, line 65 - column 3, line 57; column 5, line 26 - column 7, line 29; figures 1-4	1, 2, 4, 5	Y	--	3	X	FR, A, 2466051 (D'AUZAC) 27 March 1981 see the whole document	1, 5	Y	DE, A, 3446113 (THOMA) 10 July 1986 see the whole document	3	-----		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³																		
X	US, A, 3898643 (ETTLINGER) 5 August 1975 see column 2, line 65 - column 3, line 57; column 5, line 26 - column 7, line 29; figures 1-4	1, 2, 4, 5																		
Y	--	3																		
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Y	DE, A, 3446113 (THOMA) 10 July 1986 see the whole document	3																		

<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>♦ Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 50%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Z" document member of the same patent family</p> </div> </div>																				
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px solid black; padding: 5px;"> Date of the Actual Completion of the International Search 10th February 1989 </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report 17. 03. 89 </td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;"> International Searching Authority EUROPEAN PATENT OFFICE </td> <td style="padding: 5px;"> Signature of Authorized Officer P.C.G. VAN DER PUTTEN </td> </tr> </table>			Date of the Actual Completion of the International Search 10th February 1989	Date of Mailing of this International Search Report 17. 03. 89	International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer P.C.G. VAN DER PUTTEN														
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 8801029

SA 25559

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/03/89. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3898643	05-08-75	CA-A- 1014682	26-07-77
FR-A- 2466051	27-03-81	None	
DE-A- 3446113	10-07-86	None	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82